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STANDARD THICKNESSES OF SHEET METAL

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I. INTRODUCTION

Common or stock sizes of metal sheets are sometimes based on definite thicknesses of the sheet, and frequently on definite weights per unit area. In some cases the same kind and grade of sheet metal is made to more than one list of stock sizes or sheet metal gages. In this country the same gage is seldom used for a variety of metals. This circular is intended to furnish information as to the usual practice of American manufacturers with regard to stock thicknesses of sheets of common metals or alloys. This information has hitherto been scattered, and similar compilations previously made are largely collections of series of gage sizes only, those applying to wires being given the most attention. This circular also contains all available information with regard to manufacturing tolerances adopted by technical societies, manufacturers' associations, or used by leading manufacturers. There is apparently considerable need for unification of practice in standard thicknesses or weights per unit area of sheet metal and in method of designating sizes.

The principal gages for sheet metal in use in the United States are: The United States Standard Gage for Sheet and Plate Iron and Steel, the Galvanized Sheet Gage, the Tin Plate Gage, the American Wire Gage (Brown and Sharpe), and the Sheet Zinc Gage. The information and data included in this circular pertain to the application of these gages to various metals. There are also included herein the principal foreign gages for sheet metal, namely, the Birmingham Gage, B.G., the Paris or French Gage, the Continental Zinc Gage, and the German standards for brass, copper, and aluminum.

In the case of thickness gages, the weights per square foot given in the tables are based on specific gravities most widely accepted as being correct for rolled sheets at 20°C or 68°F.

II. IRON AND STEEL SHEET AND PLATE

1. The United States Standard Gage for Sheet and Plate Iron and Steel

The United States Standard Gage for Sheet and Plate Iron and Steel is the legal standard used in determining duties and taxes levied by the United States, and is the recognized commercial standard for all uncoated sheet and plate iron and steel. It is a weight gage, having been based upon weights in ounces per square foot. The provisions of the Act of Congress, approved March 3, 1893, (27 Stat. L., 746), establishing this gage are as follows:

A. AN ACT ESTABLISHING A STANDARD GAGE FOR SHEET AND PLATE IRON AND STEEL

Be it enacted by the Senate and House of Representative of the United States of America in Congress assembled, That for the purpose of securing uniformity, the following is established as the only standard gage for sheet and plate iron and steel in the United States of America, namely:-

Number of gage	Approximate thickness in fractions of an inch	Approximate thickness in decimal parts of an inch	Approximate thickness in millimeters	Weight per square foot in ounces avoirdupois	Weight per square foot in pounds avoirdupois	Weight per square foot in kilograms	Weight per square meter in kilograms	Weight per square meter in pounds avoirdupois
0000000	1-2	0.5	12.7	320	20.00	9.072	97.65	215.28
000000	15-32	.46875	11.90625	300	18.75	8.505	91.55	201.82
00000	7-16	.4375	11.1125	280	17.50	7.938	85.44	188.37
0000	13-32	.40625	10.31875	260	16.25	7.371	79.33	174.91
000	3-8	.375	9.525	240	15	6.804	73.24	161.46
00	11-32	.34375	8.73125	220	13.75	6,237	67.13	148.00
0	5-16	,3125	7.9375	200	12.50	5.67	61.03	134.55
1	9-32	.28125	7.14375	180	11.25	5.103	54.93	121.09
2	17-64	.265625	6.746875	170	10.625	4.819	51.88	114.37
3	1-4	.25	6.35	160	10	4.536	48.82	107.64
4	15-64	.234375	5.953125	150	9.375	4.252	45.77	100.91
5	7-32	.21875	5.55625	140	8.75	3.969	42.72	94.18
6	13-64	.203125	5.159375	130	8.125	3.685	39.67	87.45
7	3-16	.1875	4.7625	120	7.5	3.402	36.62	80.72
8	11-64	.171875	4.365625	110	6.875	3.118	33.57	74.00
9	5-32	.15625	3.96875	100	6.25	2.835	30.52	67.27
10	9-64	.140625	3.571875	90	5.625	2.552	27.46	60.55
11	1-8	.125	3.175	80	5	2.268	24.41	53.82
12	7-64	.109375	2.778125	70	4.375	1.984	21.36	47.09
13	3-32	.09375	2.38125	60	3.75	1.701	18.31	40.36
14	5-64	.078125	1.984375	50	3.125	1.417	15.26	33.64
15	9-128	.0703125	1.7859375	45	2.8125	1.276	13.73	30.27
16	1-16	.0625	1.5875	40	2.5	1.134	12.21	26.91
17	9-160	.05625	1.42875	36	2.25	1.021	10.99	24.22
18	1-20	.05	1.27	32	2.	.9072	9.765	21.53
19	7-160	.04375	1.11125	28	1.75	.7988	8.544	18.84
20	3-80	.0375	.9525	24	1.50	.6804	7.324	16.15
21	11-320	.034375	.873125	22	1.375	.6237	6.713	14.80
22	1-32	.03125	.793750	20	1.25	.567	6.103	13.46
23	9-320	.028125	.714375	18	1.125	.5103	5.493	12.11
24	1-40	.025	.635	16	1.	.4536	4.882	10.76
25	7-320	.021875	.555625	14	.875	.3969	4.272	9.42
26	3-160	.01875	.47625	12	.75	.3402	3.662	8.07
27	11-640	.0171875	.4365625	11	.6875	.3119	3.357	7.40
28	1-64	.015625	.396875	10	.625	.2835	3.052	6.73
29	9-640	.0140625	.3571875	9	.5625	.2551	2.746	6.05
30	1-80	.0125	.3175	8	.5	.2268	2.441	5.38
31	7-640	.0109375	.2778125	7	.4375	.1984	2.136	4.71
32	13-1280	.01015625	.25796875	6-1/2	.40625	.1843	1.983	4.37
33	3-320	.009375	.238125	6	.375	.1701	1.831	4.04
34	11-1280	.00859375	.21828125	5-1/2	.34375	.1559	1.678	3.70
35	5-640	.0078125	.1984375	5	.3125	.1417	1.526	3.36
36	9-1280	.00703125	.17859375	4-1/2	.28125	.1276	1.373	3.03
37	17-2560	.006640625	.168671875	4-1/4	.265625	.1205	1.297	2.87
38	1-160	.00625	.15875	4	.25	.1134	1.221	2.69

And on and after July first, eighteen hundred and ninety-three, the same and no other shall be used in determining duties and taxes levied by the United States of America on sheet and plate iron and steel. But this act shall not be construed to increase duties upon any articles which may be imported.

Sec. 2. That the Secretary of the Treasury is authorized and required to prepare suitable standards in accordance herewith.

Sec. 3. That in the practical use and application of the standard gage hereby established a variation of two and one-half per cent either way may be allowed.

Approved, March 3, 1893.

B. Approximate Thicknesses of Steel Plates and Sheets

The thicknesses given in the law as appropriate equivalents were based upon the density of wrought iron of 0.2778 pounds per cubic inch, or 480 pounds per cubic foot. Since the U. S. Standard Gage was established, wrought iron has been almost entirely superseded by steel or "Armco" iron for sheets. The density of steel is generally agreed by various authorities to be 0.2833 pounds per cubic inch or 489.6 pounds per cubic foot. Tests also have shown this value to be representative of "Armco" iron sheets.

The approximate thicknesses of both wrought iron and steel sheets are given in Table 1, and are based upon the above values, but attention is directed to the fact that the density of commercial hot-rolled steel varies considerably and is usually less than 0.2833 pounds per cubic inch, the density of forged steel. Cold rolled steel sheets are said to have a greater density than 0.2833; however, two samples of full pickled, full cold-rolled sheets showed an average density of 0.2833 pounds per cubic inch. Until a more representative value for hot-rolled sheets can be agreed upon, it is thought advisable to continue the use of the value 0.2833 pounds per cubic inch.

The action of the rolls on hot metal tends to decrease the density of the material, and of two sheets of different thicknesses rolled from the same material, the thicker sheet is always the denser. This effect is not easily explained. A similar reduction in density has been noted in hard drawn steel wire. In this case the reduction has been shown to be smaller, the greater the carbon content of the sample. (Ref. Über den Einfluss der Mechanischen Formgebung auf die Eigenshaften von Eisen und Stahl, by P. Goerens, Stahl und Eisen, March 13, 1913, Vol. 33, No. 11, pages 438-444). Reductions in density as follows were found by Goerens:

0.0012 lbs. per cu. in. for steel having 0.07% C.
.0009 " " " " " " " .55% C.
.0002 " " " " " " " .78% C.

In Table 1 the approximate thicknesses and weights are given for practical use, only to the number of decimal places warranted by the precision of measurement ordinarily attainable, and the usual variation in density. Also, the sizes above No. 38 are included, which have become standardized by custom, but were not included in the Congressional enactment.

Attention is directed to U. S. Department of Commerce Simplified Practice Recommendation No. 28, "Sheet Steel", which covers simplified sizes and weights of galvanized flat sheets, one pass cold-rolled box annealed sheets, blue annealed sheets, corrugated roofing and siding, and roofing.

Table 1. - United States Standard Gage for Sheet and Plate
Iron and Steel, and Extension

1	2	3	4	5	6	7	8	9	10	11
		Wrought Iron		Steel		Iron and Steel				
Number of gage	Approximate thickness in fractions of an inch	Approximate thickness in decimal parts of an inch	Approximate thickness in millimeters	Approximate thickness in decimal parts of an inch	Approximate thickness in millimeters	Weight per square foot in ounces avoirdupois	Weight per square foot in pounds avoirdupois	Weight per square foot in kilograms	Weight per square meter in kilograms	Weight per square meter in pounds avoirdupois
0000000	1/2	0.500	12.70	0.490	12.45	320	20.00	9.072	97.65	215.3
000000	15/32	.469	11.91	.460	11.67	300	18.75	8.505	91.55	201.8
00000	7/16	.438	11.11	.429	10.90	280	17.50	7.983	85.44	188.4
0000	13/32	.406	10.32	.398	10.12	260	16.25	7.371	79.34	174.9
000	3/8	.375	9.52	.368	9.34	240	15.00	6.804	73.24	161.5
00	11/32	.344	8.73	.337	8.56	220	13.75	6.237	67.13	148.0
0	5/16	.312	7.94	.306	7.78	200	12.50	5.670	61.03	134.6
1	9/32	.2812	7.14	.2758	7.00	180	11.25	5.103	54.93	121.1
2	17/64	.2656	6.75	.2604	6.62	170	10.62	4.819	51.88	114.4
3	1/4	.2500	6.35	.2451	6.23	160	10.00	4.536	48.82	107.6
4	15/64	.2344	5.95	.2298	5.84	150	9.375	4.252	45.77	100.9
5	7/32	.2188	5.56	.2145	5.45	140	8.750	3.969	42.72	94.18
6	13/64	.2031	5.16	.1992	5.06	130	8.125	3.685	39.67	87.45
7	3/16	.1875	4.76	.1838	4.67	120	7.500	3.402	36.62	80.72
8	11/64	.1719	4.37	.1685	4.28	110	6.875	3.118	33.57	74.00
9	5/32	.1562	3.97	.1532	3.89	100	6.250	2.835	30.52	67.27
10	9/64	.1406	3.57	.1379	3.50	90	5.625	2.552	27.46	60.55
11	1/8	.1250	3.18	.1226	3.11	80	5.000	2.268	24.41	53.82
12	7/64	.1094	2.778	.1072	2.724	70	4.375	1.984	21.36	47.09
13	3/32	.0938	2.381	.0919	2.335	60	3.750	1.701	18.31	40.36
14	5/64	.0781	1.984	.0766	1.946	50	3.125	1.417	15.26	33.64
15	9/128	.0703	1.786	.0689	1.751	45	2.812	1.276	13.73	30.27
16	1/16	.0625	1.588	.0613	1.557	40	2.500	1.134	12.21	26.91
17	9/160	.0562	1.429	.0552	1.401	36	2.250	1.021	10.99	24.22
18	1/20	.0500	1.270	.0490	1.245	32	2.000	0.9072	9.765	21.53
19	7/160	.0438	1.111	.0429	1.090	28	1.750	.7938	8.544	18.84
20	3/80	.0375	0.952	.0368	0.934	24	1.500	.6804	7.324	16.15
21	11/320	.0344	.873	.0337	.856	22	1.375	.6237	6.713	14.80
22	1/32	.0312	.794	.0306	.778	20	1.250	.5670	6.103	13.46
23	9/320	.0281	.714	.0276	.700	18	1.125	.5103	5.493	12.11
24	1/40	.0250	.635	.0245	.623	16	1.000	.4536	4.882	10.76
25	7/320	.0219	.556	.0214	.545	14	0.8750	.3969	4.272	9.42
26	3/160	.0188	.476	.0184	.467	12	.7500	.3402	3.662	8.07
27	11/640	.0172	.437	.0169	.428	11	.6875	.3119	3.357	7.40
28	1/64	.0156	.397	.0153	.389	10	.6250	.2835	3.052	6.73
29	9/640	.0141	.357	.0138	.350	9	.5625	.2551	2.746	6.05
30	1/80	.0125	.318	.0123	.311	8	.5000	.2268	2.441	5.38
31	7/640	.0109	.278	.0107	.272	7	.4375	.1984	2.136	4.71
32	13/1280	.0102	.258	.0100	.253	6-1/2	.4062	.1843	1.983	4.37
33	3/320	.0094	.238	.0092	.233	6	.3750	.1701	1.831	4.04
34	11/1280	.0086	.218	.0084	.214	5-1/2	.3438	.1559	1.678	3.70
35	5/640	.0078	.198	.0077	.195	5	.3125	.1417	1.526	3.36
36	9/1280	.0070	.179	.0069	.175	4-1/2	.2812	.1276	1.373	3.03
37	17/2560	.0066	.169	.0065	.165	4-1/4	.2656	.1205	1.297	2.87
38	1/160	.0062	.159	.0061	.156	4	.2500	.1134	1.221	2.69
39	15/2560	.0059	.149	.0057	.146	3-3/4	.2344	.1063	1.144	2.52
40	7/1280	.0055	.139	.0054	.136	3-1/2	.2188	.0992	1.068	2.35
41	27/5120	.0053	.134	.0052	.131	3-3/8	.2109	.0957	1.030	2.27
42	13/2560	.0051	.129	.0050	.126	3-1/4	.2031	.0921	0.9917	2.19
43	25/5120	.0049	.124	.0048	.122	3-1/8	.1953	.0886	.9536	2.10
44	3/640	.0047	.119	.0046	.117	3	.1875	.0850	.9155	2.02

C. Permissible Variations in Weight and Thickness

Manufacturers have had considerable difficulty in keeping within the tolerance of plus or minus 2 1/2 per cent specified in the law establishing the U. S. Standard Gage for Sheet and Plate Iron and Steel, particularly on the heavier plate. As the law does not make this tolerance mandatory for commercial purposes, the Association of American Steel Manufacturers have adopted the following specifications regarding permissible variations in weight and thickness, which have been applied to plate mill products regularly, but not to sheet and tin mill products: (See "Manufacturers' Standard Specifications for Structural and Boiler Steel", The Association of American Steel Manufacturers, Revised November 24, 1922.)

(a) The sectional area or weight of each structural shape, and of each rolled-edge plate up to and including 36 in. in width, shall not vary more than 2.5 per cent from the theoretical or specified amounts.

(b) The thickness or weight of sheared mill plates, and of universal mill plates over 36 in. in width, shall conform to the Manufacturers' standard practice governing the permissible variations for sheared mill plates, as given in Tables 2 and 3 herein.

(c) Sheared Plates, When Ordered to Weight per Square Foot: The weight of each lot[a] in each shipment shall not vary from the weight ordered more than the amount given in Table 2. This table shall not be used when a minimum edge thickness is required. In such cases the table of permissible variations for plates ordered to thickness shall apply.

(d) Sheared Plates, When Ordered to Thickness: The thickness of each plate shall not vary more than 0.01 inch under the thickness ordered, and the overweight of each lot[a] in each shipment shall not exceed the amount given in Table 3.

Tables of permissible rolling variations in weight and thickness of sheared plates were adopted by the Association of American Steel Manufacturers in 1896. These tables were revised from time to time, the latest revision as to percentages of overweight being made in 1916. The 1916 revision was adopted by the American Society for Testing Materials, and the tables appear in the following of its specifications:

Note a: The term "lot" applied to these tables means all of the plates of each group width and each group thickness or weight.

TABLE 2. Permissible Variations in Weight of Rectangular Sheared Plates Ordered to Weight

Ordered weight, pounds per square foot	Permissible variations in average weight per square foot of plates for widths given Expressed in percentage of ordered weights																	
	Under 48 in.		48 in. incl. to 60 in. excl.		60 in. incl. to 72 in. excl.		72 in. incl. to 84 in. excl.		84 in. incl. to 96 in. excl.		96 in. incl. to 108 in. excl.		108 in. incl. to 120 in. excl.		120 in. incl. to 132 in. excl.		132 in. incl. to 144 in. excl.[a]	
	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under
Under 5	5	3	5.5	3	6	3	7	3	..	..	..	..	..	..	..	..	..	..
5 incl. to 7.5 excl.	4.5	3	5	3	5.5	3	6	3	..	..	..	..	..	..	..	..	..	..
7.5 " to 10 "	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	..	..	..	..
10 " to 12.5 "	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3	9	3
12.5 " to 15 "	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3	8	3
15 " to 17.5 "	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3	7	3
17.5 " to 20 "	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3	6	3
20 " to 25 "	2	2	2.5	2	2.5	2.5	3	2.5	3.5	2.5	4	3	4.5	3	5	3	5.5	3
25 " to 30 "	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3	5	3
30 " to 40 "	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3	4.5	3
40 or over	2	2	2	2	2	2	2	2	2.5	2	2.5	2.5	3	2.5	3.5	3	4	3

Note.- The weight per square foot of individual plates shall not vary from the ordered weight by more than 1-1/3 times the amount given in this table.

TABLE 3. Permissible Overweights of Rectangular Steel Plates Ordered to Thickness

Ordered thickness, inch	Permissible excess in average weight per square foot of plates for widths given Expressed in percentage of nominal weight								
	Under 48 in.	48 in. incl. to 60 in. excl.	60 in. incl. to 72 in. excl.	72 in. incl. to 84 in. excl.	84 in. incl. to 96 in. excl.	96 in. incl. to 108 in. excl.	108 in. incl. to 120 in. excl.	120 in. incl. to 132 in. excl.	132 in. incl. to 144 in. excl.
Under 1/8	9	10	12	14	..	..	..	..	..
1/8 incl. to 3/16 excl.	8	9	10	12	..	..	..	..	..
3/16 " to 1/4 "	7	8	9	10	12	..	..	..	..
1/4 " to 5/16 "	6	7	8	9	10	12	14	16	19
5/16 " to 3/8 "	5	6	7	8	9	10	12	14	17
3/8 " to 7/16 "	4.5	5	6	7	8	9	10	12	15
7/16 " to 1/2 "	4	4.5	5	6	7	8	9	10	13
1/2 " to 5/8 "	3.5	4	4.5	5	6	7	8	9	11
5/8 " to 3/4 "	3	3.5	4	4.5	5	6	7	8	9
3/4 " to 1 "	2.5	3	3.5	4	4.5	5	6	7	8
1 to over	2.5	2.5	3	3.5	4	4.5	5	6	7

Note a. In A.S.T.M. specifications, the last column in the above tables is headed: "132 in. or over."

Note b. The weight of individual plates ordered to thickness shall not exceed the nominal weight by more than 1 1/3 times the amount given in the above table.

Standard	Specifications	(A 7 -24)	for Structural Steel for Bridges.
"	"	(A 8 -24)	" " Nickel Steel.
"	"	(A 9 -24)	" " Steel for Buildings.
"	"	(A10 -24)	" " " " Locomotives
"	"	(A11 -24)	" " " " Cars
"	"	(A12 -24)	" " " " Ships
"	"	(A30 -24)	" " Boiler and Firebox Steel for Locomotives (Table 3 only).
"	"	(A70 -24)	" Boiler and Firebox Steel for Stationary Service(Table 3 only)
Tentative	"	(A78 -23T)	" Steel Plates of Structural Quality for Forge Welding.
"	"	(A89 -23T)	" Steel Plates of Flange Quality for Forge Welding.

2. Galvanized Sheet Gage

The Galvanized Sheet Gage, given in Table 4, is based upon the United States Standard Gage for Sheet and Plate Iron and Steel; 2.5 ounces per square foot being added to the weight per square foot of a given gage number of the United States Standard Gage, to determine the weight per square foot of the corresponding gage number of the Galvanized Sheet Gage. This gage is considered standard in the United States, having been established by custom.

The resistance of galvanized sheet to corrosion depends on the purity, evenness, and weight of coating; also on the degree of deformation in forming the sheet to some definite shape. A heavy coating on a sheet tends to crack or to peel in forming, and, therefore, a continuous thin coating is considered more desirable when the sheet is to be formed. Attention is being given at the present time to standards for weights of coating by certain standardizing bodies. In Table 5 are given the tentative specifications of the American Society for Testing Materials. Those thicknesses which are not included in the list of simplified sizes issued by the U.S.Department of Commerce in Simplified Practice Recommendation No. 28, "Sheet Steel", are indicated by an asterisk.

Table 4.- Galvanized Sheet Gage

1 Number of Gage	2 Weight per square foot Pounds	3 Weight per square foot Ounces
8	7.031	112.5
9	6.406	102.5
10	5.781	92.5
11	5.156	82.5
12	4.531	72.5
13	3.906	62.5
14	3.281	52.5
15	2.969	47.5
16	2.656	42.5
17	2.406	38.5
18	2.156	34.5
19	1.906	30.5
20	1.656	26.5
21	1.531	24.5
22	1.406	22.5
23	1.281	20.5
24	1.156	18.5
25	1.031	16.5
26	0.906	14.5
27	.844	13.5
28	.781	12.5
29	.719	11.5
30	.656	10.5
31	.594	9.5
32	.563	9.0
33	.531	8.5
34	.500	8.0

TABLE 5.- Tentative Specifications for Weights of Hot-Dipped Galvanized Sheets, American Society for Testing Materials.

(See A.S.T.M. Tentative Specification A 93-24 T).

1	2	3	4	5	6	7
Gage number	Minimum average weight of coating, Oz. per sq. ft.			Weights of galvanized sheets, all classes, Oz. per sq. ft.		
	Class A	Class B	Class C	Minimum	Nominal	Maximum
8*	2.50	2.00	1.75	106.9	112.5	118.1
9*	2.50	2.00	1.75	97.4	102.5	107.6
10*	2.50	2.00	1.75	87.9	92.5	97.1
11*	2.50	2.00	1.75	78.4	82.5	86.6
12	2.50	2.00	1.75	68.9	72.5	76.1
14	2.50	2.00	1.75	49.9	52.5	55.1
16	2.50	2.00	1.75	40.4	42.5	44.6
18	2.50	2.00	1.50	33.3	34.5	35.7
20	2.50	2.00	1.50	25.6	26.5	27.4
22	2.50	2.00	1.50	21.7	22.5	23.3
24	- --	2.00	1.30	18.0	18.5	19.0
26	- --	2.00	1.10	14.1	14.5	14.9
27*	- --	2.00	1.10	13.2	13.5	13.8
28	- --	1.80	1.10	12.2	12.5	12.8
29	- --	1.60	1.10	11.2	11.5	11.8
30	- --	1.40	1.10	10.2	10.5	10.8

The weight of coating specified in the above table is the total coating on both sides of a sheet 1 ft. square. In determining the weight of coating the average is taken of the chemical determination from three specimens 2 1/4 in. square cut from the middle and from diagonally opposite corners at least 4 inches from the end of a representative sheet.

The average weights per square foot specified in the above table are based on a maximum variation from the nominal weight of 5 per cent for gages Nos. 8 to 16, inclusive, 3 1/2 percent for gages 17 to 22, inclusive, and 2 1/2 per cent for gages thinner than No. 22.

Gage numbers included in the above table which are not given in the list of simplified sizes issued by the U. S. Department of Commerce in Simplified Practice Recommendation No. 28, "Sheet Steel", are indicated by an asterisk.

3. Tin Plate Gage

Tin plates, which consist of soft sheet steel coated with tin, and Terne plates in which the coating is approximately 25% tin and 75% lead, are measured in a unit of area known as the base box. This is an old English unit amounting to 31,360 square inches and is independent of thickness. Tin plates are customarily made in sizes of 10 x 14 inches and multiples thereof, the most commonly used sizes being 14 x 20 and 20 x 28 inches. The base box corresponds to 112 plates, 14 x 20 inches.

In Table 6 are given the essential dimensions and trade symbols of the Tin Plate Gage as published in the Reference Book of the American Sheet and Tin Plate Company. This gage is established by long custom and the symbols noted in the table are inherited from the British industry. It should be borne in mind that the corrosion resisting qualities of both tin and terne plate depend on the thickness of the coating rather than on the total thickness of the plate. Tin plate comes in a number of grades usually designated by "A", "AAA", "AAAA", and so forth, the greater the number of A's in the symbol, the thicker the coating. AAA tin plate has approximately 4 lbs. of tin coating per base box.

Terne plate, used extensively as roofing tin, is manufactured in standard weights of coating of 8, 15, 20, 25, 30, 32, and 40 pounds per double base box. For roofing it is accepted practice to manufacture terne plates not lighter than IC thickness. (See U.S. Department of Commerce Simplified Practice Recommendation No. 30, "Terne Plate").

Table 5. - Tin Plate Gage

1	2	3	4
Trade Symbol	Pounds per base box	Pounds per square foot	*Approximate equivalent thickness
			inches
55-pounds	55	0.253	0.0062
60- "	60	.276	.0068
65- "	65	.298	.0073
70- "	70	.321	.0079
75- "	75	.344	.0084
80- "	80	.367	.0090
85- "	85	.390	.0096
90- "	90	.413	.0101
95- "	95	.436	.0107
I C L	100	.459	.0113
I C	107	.491	.0120
112-pounds	112	.514	.0126
118- "	118	.542	.0133
I X L	128	.588	.0144
I X	135	.620	.0152
D C	139	.638	.0156
2 X L	148	.680	.0167
2 X	155	.712	.0174
3 X L	168	.771	.0189
3 X	175	.804	.0197
D X	180	.827	.0203
4 X L	188	.863	.0212
4 X	195	.895	.0219
5 X L	208	.955	.0234
D 2 X	210	.964	.0236
5 X	215	.987	.0242
6 X L	228	1.047	.0257
6 X	235	1.079	.0264
D 3 X	240	1.102	.0270
7 X L	248	1.139	.0279
7 X	255	1.171	.0287
8 X L	268	1.231	.0302
D 4 X	270	1.240	.0304
8 X	275	1.263	.0309

*Assuming that tin plate weighs 0.2833 lbs. per cubic inch, or 489.6 lbs. per cubic foot.

III. NON-FERROUS PLATE, SHEET, AND STRIP

1. American Wire Gage (Copper, Brass, Aluminum, etc.)

The American Wire Gage is extensively used in the United States for nearly all non-ferrous sheets, particularly copper, brass, aluminum and nickel-silver (German silver) sheets, as well as for wire of the same materials. It was devised by J. R. Brown and Lucian Sharpe, founders of the Brown and Sharpe Manufacturing Company, in 1856, and was adopted by the Association of Brass Manufacturers in February, 1857, eight of the leading brass manufacturers signing the resolutions. Its gage numbers, like those of the United States Standard Gage and many other gages are retrogressive, a larger number denoting a smaller size. The gage is based on a simple mathematical law of geometrical progression, which may be expressed in either of three following manners:-

(a) The ratio of any size to the next smaller is a constant number, namely, the 39th root of $\frac{.460}{.005}$ = 1.1229322.

(b) The difference between any two successive sizes is a constant percentage of the smaller of the two sizes, namely, .1229322.

(c) The difference between any two successive sizes is a constant ratio times the next smaller difference between two successive sizes, namely 1.1229322.

When the gage was developed the size No. 0000 was defined as 0.4600, and of No. 36 as 0.005 inch, and it was specified that there should be 38 sizes between the two which should advance by geometrical progression. The sixth power of the ratio 1.1229322 is 2.0050, so that the thickness and consequently the weight per unit area of a sheet six sizes heavier than a given size, is approximately twice as great.

A. Approximate Weights per Square Foot

In Table 7, the size numbers and thickness of the American Wire Gage are given, together with the approximate weights per square foot of rolled copper, brass and aluminum sheets. The weights of copper sheets given in this table are based on the density 8.89 grams per cubic centimeter, or 555 pounds per cubic foot, since that is the value adopted as standard by the American Institute of Electrical Engineers and by the International Electro-Technical Commission; also adopted by the American Society for Testing Materials for hard drawn copper wire and annealed copper. The weights given in the table are, therefore, for cold rolled and annealed copper sheets. Hot rolled copper plates having a thickness of 5/16 inch, and over, are about 1/2 per cent heavier, the density being 8.94 g per cc or 558 lbs. per cubic foot, according to A.S.T.M. Standard Specifications for Copper Plates for Locomotive Fireboxes, 1918.

TABLE 7.- American Wire Gage, - Weights of Copper, Brass and Aluminum Sheets and Plates

1	2	3	4	5	6
Number of gage	Thickness in decimal parts of an inch	Thickness in millimeters	Approximate weight per square foot in pounds avoirdupois*		
			Copper	Brass	Aluminum
0000	0.4600	11.68	21.27	20.48	6.485
000	.4096	10.40	18.95	18.24	5.775
00	.3648	9.266	16.87	16.25	5.143
0	.3249	8.252	15.02	14.47	4.580
1	.2893	7.348	13.38	12.88	4.079
2	.2576	6.544	11.91	11.47	3.632
3	.2294	5.827	10.61	10.22	3.234
4	.2043	5.189	9.449	9.098	2.880
5	.1819	4.621	8.415	8.102	2.565
6	.1620	4.115	7.493	7.215	2.284
7	.1443	3.665	6.673	6.425	2.034
8	.1285	3.264	5.943	5.722	1.811
9	.1144	2.906	5.292	5.096	1.613
10	.1019	2.588	4.713	4.538	1.437
11	.0907	2.305	4.197	4.041	1.279
12	.0808	2.053	3.737	3.599	1.139
13	.0720	1.828	3.328	3.205	1.015
14	.0641	1.628	2.964	2.854	0.9035
15	.0571	1.450	2.639	2.541	.8046
16	.0508	1.291	2.350	2.263	.7165
17	.0453	1.150	2.093	2.015	.6381
18	.0403	1.024	1.864	1.795	.5682
19	.0359	0.9116	1.660	1.598	.5060
20	.0320	.8118	1.478	1.423	.4506
21	.0285	.7230	1.316	1.267	.4013
22	.0253	.6438	1.172	1.129	.3573
23	.0226	.5733	1.044	1.005	.3182
24	.0201	.5106	0.9296	0.8951	.2834
25	.0179	.4547	.8279	.7971	.2524
26	.0159	.4049	.7372	.7099	.2247
27	.0142	.3606	.6565	.6322	.2001
28	.0126	.3211	.5847	.5630	.1782
29	.0113	.2859	.5207	.5013	.1587
30	.0100	.2546	.4637	.4464	.1413
31	.00893	.2268	.4129	.3976	.1259
32	.00795	.2019	.3677	.3540	.1121
33	.00708	.1798	.3274	.3153	.09982
34	.00630	.1601	.2916	.3808	.08889
35	.00561	.1426	.2597	.2500	.07916
36	.00500	.1270	.2312	.2227	.07049
37	.00445	.1131	.2059	.1983	.06277
38	.00397	.1007	.1834	.1766	.05590
39	.00353	.0897	.1633	.1572	.04978
40	.00314	.0799	.1454	.1400	.04433

*The last decimal place in the values given in Columns 4, 5, and 6 represents an order of accuracy higher than that which should ordinarily be used on account of slight variations in density of commercial material.

The weights of brass sheets are based on a density of 8.56 grams per cubic centimeter, or 534 pounds per cubic foot, which is the value for rolled yellow brass given in the Smithsonian Tables, 1920. The weights of aluminum sheets are based on the density 2.71 grams per cubic centimeter, or 169.2 pounds per cubic foot, this value being commonly accepted as the average density of rolled commercial sheets.

B. Permissible Variations in Thickness and Weight

The available data as to tolerances applied to thicknesses of copper, aluminum, brass and other non-ferrous alloy plates, sheets, and strips, are given in Tables 8 to 12, inclusive. The sources of these tables and their applications are as follows:

Table number	Metal or alloy	References
8	Naval brass	U. S. Army Ordnance Dept. Metal Specification No. 57-162, April 30, 1923 (gages 0000 to 12, inclusive, only).
8	Aluminum bronze	U.S. Army Ordnance Dept. Metal Specification No. 57-165, April 30, 1923. Society of Automotive Engineers Specification No. 69, August 1924.
8	Phosphor bronze	U. S. Army Ordnance Dept. Metal Specification No. 57-167, May 3, 1923. Society of Automotive Engineers Specification No. 77, August 1924.
8	Cupro-nickel	U. S. Army Ordnance Dept. Metal Specification No. 57-169, May 3, 1923.
8	Nickel silver (German silver)	U. S. Army Ordnance Dept. Metal Specification No. 57-170, May 3, 1923
9	Copper	U. S. Army Ordnance Dept. Metal Specification No. 57-154, April 30, 1923. Society of Automotive Engineers Specification No. 71, August 1924.
9	Low and rich low brass	U. S. Army Ordnance Dept. Metal Specification No. 57-160, December 20, 1923.
9	Commercial brass	U. S. Army Ordnance Dept. Metal Specification No. 57-161, May 3, 1923. Society of Automotive Engineers Specification No. 70, August 1924.
9	Gilding metal	U. S. Army Ordnance Dept. Metal Specification No. 57-171, May 3, 1923.
10.	High sheet brass	American Society for Testing Materials Standard Specification No. B 36-21
11,12	Aluminum	See references under Tables 11 and 12.

TABLE 8.- Permissible Variations in Thickness of Wrought Non-Ferrous Alloy Sheets and Strips

1	2	3	4	5	6
American wire (B.& S.) gage number	Thickness	Up to 6 in. wide inclusive	Up to 9 in. wide inclusive	Up to 14 in. wide inclusive	Up to 20 in. wide inclusive
	Inch	Inch ±	Inch ±	Inch ±	Inch ±
0000	0.4600	0.0054	0.0056	0.0059	0.0061
000	.4096	.0053	.0055	.0058	.0060
00	.3648	.0051	.0054	.0056	.0059
0	.3249	.0050	.0053	.0055	.0058
1	.2893	.0049	.0051	.0054	.0056
2	.2576	.0048	.0050	.0053	.0055
3	.2294	.0046	.0049	.0051	.0054
4	.2043	.0045	.0048	.0050	.0053
5	.1819	.0044	.0046	.0049	.0051
6	.1620	.0043	.0045	.0048	.0050
7	.1443	.0041	.0044	.0046	.0049
8	.1285	.0040	.0043	.0045	.0048
9	.1144	.0039	.0041	.0044	.0046
10	.1019	.0038	.0040	.0043	.0045
11	.0907	.0036	.0039	.0041	.0044
12	.0808	.0035	.0038	.0040	.0043
13	.0720	.0034	.0036	.0039	.0041
14	.0641	.0033	.0035	.0038	.0040
15	.0571	.0031	.0034	.0036	.0039
16	.0508	.0030	.0033	.0035	.0038
17	.0453	.0029	.0031	.0034	.0036
18	.0403	.0028	.0030	.0033	.0035
19	.0359	.0026	.0029	.0031	.0033
20	.0320	.0025	.0026	.0029	.0030
21	.0285	.0024	.0025	.0026	.0028
22	.0253	.0023	.0024	.0025	.0026
23	.0226	.0021	.0023	.0024	.0025
24	.0201	.0020	.0021	.0023	.0024
25	.0179	.0019	.0020	.0021	.0023
26	.0159	.0018	.0019	.0020	.0021
27	.0142	.0016	.0018	.0019	.0020
28	.0126	.0015	.0016	.0018	.0019
29	.0113	.0014	.0015	.0016	.0018
30	.0100	.0014	.0015	.0016	.0018
31	.0089	.0013	.0014	.0015	.0016
32	.0079	.0013	.0014	.0015	.0016
33	.0071	.0011	.0013	.0014	.0015
34	.0063	.0011	.0013	.0014	.0015
35	.0056	.0010	.0011	.0013	.0014
36	.0050	.0010	.0011	.0013	.0014

TABLE 9.- Permissible Variations in Thickness of Wrought Non-Ferrous Alloy Sheets and Strips

1	2	3	4	5	6
American wire (B.& S.) gage number	Thickness	Up to 6 in. wide inclusive	Up to 9 in. wide inclusive	Up to 14 in. wide inclusive	Up to 20 in. wide inclusive
	Inch	Inch ±	Inch ±	Inch ±	Inch ±
0000	0.4600	0.0043	0.0045	0.0047	0.0049
000	.4096	.0042	.0044	.0046	.0048
00	.3648	.0041	.0043	.0045	.0047
0	.3249	.0040	.0042	.0044	.0046
1	.2893	.0039	.0041	.0043	.0045
2	.2576	.0038	.0040	.0042	.0044
3	.2294	.0037	.0039	.0041	.0043
4	.2043	.0036	.0038	.0040	.0042
5	.1819	.0035	.0037	.0039	.0041
6	.1620	.0034	.0036	.0038	.0040
7	.1443	.0033	.0035	.0037	.0039
8	.1285	.0032	.0034	.0036	.0038
9	.1144	.0031	.0033	.0035	.0037
10	.1019	.0030	.0032	.0034	.0036
11	.0907	.0029	.0031	.0033	.0035
12	.0808	.0028	.0030	.0032	.0034
13	.0720	.0027	.0029	.0031	.0033
14	.0641	.0026	.0028	.0030	.0032
15	.0571	.0025	.0027	.0029	.0031
16	.0508	.0024	.0026	.0028	.0030
17	.0453	.0023	.0025	.0027	.0029
18	.0403	.0022	.0024	.0026	.0028
19	.0359	.0021	.0023	.0025	.0026
20	.0320	.0020	.0021	.0023	.0024
21	.0285	.0019	.0020	.0021	.0022
22	.0253	.0018	.0019	.0020	.0021
23	.0226	.0017	.0018	.0019	.0020
24	.0201	.0016	.0017	.0018	.0019
25	.0179	.0015	.0016	.0017	.0018
26	.0159	.0014	.0015	.0016	.0017
27	.0142	.0013	.0014	.0015	.0016
28	.0126	.0012	.0013	.0014	.0015
29	.0113	.0011	.0012	.0013	.0014
30	.0100	.0011	.0012	.0013	.0014
31	.0089	.0010	.0011	.0012	.0013
32	.0079	.0010	.0011	.0012	.0013
33	.0071	.0009	.0010	.0011	.0012
34	.0063	.0009	.0010	.0011	.0012
35	.0056	.0008	.0009	.0010	.0011
36	.0050	.0008	.0009	.0010	.0011

TABLE 10.- Permissible Variations in Thickness, High Sheet Brass. Standard Specifications, American Society for Testing Materials, B 36-21.
Approved July 19, 1924, as "Tentative American Standard" by the American Engineering Standards Committee

Thickness, American Wire Gage number	Thickness	Width, inches			
		Up to 5 incl.	Over 5 to 8, incl.	Over 8 to 11, incl.	Over 11 to 14, incl.
	Inch	Inch	Inch	Inch	Inch
0000 to 0, incl.	0.4600 to 0.2248	±0.0044	±0.0048	±0.0051	±0.0055
Below 0 to 4, incl.	.3248 to .2043	± .0039	± .0043	± .0046	± .0050
" 4 " 8, "	.2043 " .1284	± .0034	± .0038	± .0041	± .0045
" 8 " 14, "	.1284 " .0640	± .0029	± .0033	± .0036	± .0040
" 14 " 18, "	.0640 " .0403	± .0025	± .0029	± .0033	± .0037
" 18 " 24, "	.0403 " .0201	± .0020	± .0024	± .0028	± .0032
" 24 " 28, "	.0201 " .0126	± .0016	± .0020	± .0024	± .0028
" 28 " 32, "	.0126 " .0079	± .0013	± .0017	± .0020	± .0024
" 32 " 35, "	.0079 " .0056	± .0010	± .0014	± .0017	± .0022
" 35 " 38, "	.0056 " .0039	± .0008	± .0012	± .0015	± .0019

The standard method of specifying thickness shall be in terms of the American Wire Gage (Brown and Sharpe). When the thickness is specified in either common or decimal fractions of an inch, the tolerances shall be those of the corresponding group of American Wire Gage sizes in this table.

TABLE 11.- Permissible Variations in Thickness of Flat and Coiled Aluminum Sheet, Commercial Practice

1	2	3	4	5	6	7
merican Wire Gage number	Thickness	Tolerances for widths of:				
		20 inches and less	Over 20 to 36 inches incl.	Over 36 to 60 inches incl.	1/4 to 12 inches incl.	Over 12 to 24 inches incl.
	Inch	Inch	Inch	Inch	Inch	Inch
		FLAT SHEET				
and 3	0.2576 and .2294	±0.0070	±0.0080	±0.0090		
4 to 9 incl.	.2043 to .1144	± .0050	± .0060	± .0070		
0 " 13 "	.1019 " .0720	± .0030	± .0035	± .0040		
4 " 21 "	.0641 " .0285	± .0025	± .0025	± .0030		
2 " 24 "	.0253 " .0201	± .0020	± .0020	± .0030		
5 " 27 "	.0179 " .0142	± .0020	± .0020	± .0020		
8 " 36 "	.0126 " .0050	± .0015	± .0015	± .0015		
		COILED SHEET				
0 to 18 incl.	0.1019 to .0403				±0.0030	±0.0030
9 " 20 "	.0359 " .0320				± .0020	± .0025
1 " 25 "	.0285 " .0179				± .0020	± .0025
6 " 29 "	.0159 " .0113				± .0015	
0 " 36 "	.0100 " .0050				± .0010	

ote: The above tolerances are taken from Aluminum Company of America Data Sheet No. 669 742, March 1, 1924.

TABLE 12.- Permissible Variations in Thickness of Aluminum Plate, Sheet, and Strip

1	2	3	4	5
		Permissible variations in thickness		
		U.S.Army specifications, 1923		A.S.T.M. tentative specifications, 1919
American Wire Gage number	Thickness	30 inches wide and less	Over 30 inches wide	
	Inch	Inch ±	Inch ±	Inch ±
4 and over	0.2043 and over	0.0100	0.0100	
5 to 9 incl.	.1819 to .1144	.0060	.0065	
10 " 13 "	.1019 " .0720	.0030	.0035	0.0030
14 " 17 "	.0641 " .0453	.0030	.0035	.0030
18 " 21 "	.0403 " .0285	.0025	.0030	.0020
22 " 24 "	.0253 " .0201	.0020	.0025	.0020
25	.0179	.0020	.0025	.0020
26	.0159	.0020	.0025	.0020
27	.0142	.0015	.0020	
28	.0126	.0015	.0020	
29	.0113	.0015	.0020	
30	.0100	.0015	.0020	

Notes: Columns 3 and 4 are taken from U.S.Army Ordnance Department Metal Specification No. 57-151, May 9, 1923. The tolerances given in columns 3 also apply to aluminum-alloy plates, sheets, and strips, - U.S.Army Ordnance Department Metal Specification No. 57-152, May 25, 1923.

Column 5 is taken from American Society for Testing Materials Tentative Specifications No. B 25-19 T.

2. Other Gages for Copper Sheets

Copper sheets are frequently made in definite weights per square foot. This practice is quite common in the heavier flat sheets. Table 13 shows the corresponding approximate thicknesses, which are based on a density of 8.89 grams per cubic centimeter or 555 lbs. per cubic foot.

Copper sheets can also be obtained in fractional inch sizes varying by sixteenths of an inch from 1/16 to 2 inches. Also the Birmingham or Stubs wire gage has been used in designating sizes of copper sheets. Table 14 gives permissible variations in weight and thickness of certain fractional inch sizes.

TABLE 13.- Copper Sheets Furnished in Weights per Square Foot

1	2	3	4
Weight per square foot	Approximate thickness	Weight per square foot	Approximate thickness
Ounces	Inch	Pounds	Inch
2	0.0027	5	0.1081
4	.0054	5 1/2	.1189
6	.0081	6	.1297
7	.0095	6 1/2	.1405
8	.0108	7	.1514
9	.0122	7 1/2	.1622
10	.0135	8	.1730
11	.0149	8 1/2	.1838
12	.0162	9	.1946
13	.0176	9 1/2	.2054
14	.0189	10	.2162
15	.0203	11	.2378
16	.0216	12	.2595
18	.0243	13	.2811
20	.0270	14	.3027
24	.0324	15	.3243
26	.0351	16	.3460
28	.0378		
32	.0432		
36	.0486		
40	.0541		
44	.0595		
46	.0622		
48	.0649		
52	.0703		
56	.0757		
64	.0865		
72	.0973		
76	.1027		

TABLE 14.- Permissible Overweights of Copper Plates for Locomotive Fireboxes, Ordered to Thickness
Standard Specifications, American Society for Testing Materials, B 11-18

1	2	3	4	5	6
Ordered thickness	Weight, lb.per sq.ft.	Permissible excess in average weights per square foot of plates for widths given Expressed in percentages of nominal weights			
		Under 75 in.	75 to 100 in., excl.	100 to 115 in., excl.	115 in.or over
Inches					
5/16....	14.53	8	12	16	..
3/8	17.44	7	10	13	17
7/16....	20.34	6	8	10	13
1/2	23.25	5		9	12
9/16....	26.16		6.5	8.5	11
5/8.....	29.06	5	6	8	10
Over 5/8	.. ..	5	5	6.5	9

The thickness of each plate shall not vary more than 0.04 in. under that ordered.

3. Monel Metal

Monel metal is a non-corrodible, natural alloy, comparable with the better grades of steel in strength, toughness and ductility. Its composition is approximately 67% nickel, 28% copper and 5% of other elements. Monel metal sheets are rolled in thicknesses corresponding to the thickness sizes of the U.S. Standard Gage for Sheet and Plate Iron and Steel. The corresponding weights per unit area are given in Table 15. Inasmuch as the U.S. sheet metal gage is strictly a weight gage, this practice with regard to sizes of monel metal sheets represents a deviation from the standard practice. Monel metal sheets are usually used to replace sheet metal steel, or steel sheets coated with zinc, which come in sheet metal gage sizes. If monel metal sheets were rolled to the same weight per unit area as the sheet metal gage, the resulting thicknesses would be quite different from standard steel sheet thicknesses, because of the large difference in density of the two metals. This is the reason given for the practice.

The tolerances on thickness given in Table 15 are the practice of the International Nickel Company. When rolled to weight, it's tolerances correspond to sheet steel practice. Permissible variations in thickness adopted by the U.S.Army, given in Ordnance Department Metal Specifications No. 57-168, May 15, 1923, are shown in Table 16.

TABLE 15.- Monel Metal Sheets

1	2	3	4	5	6
	Thickness			*Weight per square foot	
Number of gage	In fractions of an inch	In decimal parts of an inch	Tolerances, inch	In ounces**	In pounds
2	17/64	0.2656		194-1/2	12.211
3	1/4	.2500	±0.008	183	11.493
4	15/64	.2344	± .008	171-3/4	10.774
5	7/32	.2188	± .007	160-1/4	10.056
6	13/64	.2031	± .007	148-3/4	9.338
7	3/16	.1875	± .005	137-1/2	8.619
8	11/64	.1719	± .004	126	7.901
9	5/32	.1562	± .004	114-1/2	7.183
10	9/64	.1406	± .004	103	6.465
11	1/8	.1250	± .003	91-1/2	5.746
12	7/64	.1094	± .003	80-1/4	5.028
13	3/32	.0938	± .003	68-3/4	4.310
14	5/64	.0781	± .003	57-1/4	3.591
15	9/128	.0703	± .003	51-1/2	3.232
16	1/16	.0625	± .002	45-3/4	2.873
17	9/160	.0562	± .002	41	2.586
18	1/20	.0500	± .002	36-1/2	2.300
19	7/160	.0438	± .002	32	2.011
20	3/80	.0375	± .001	27-1/2	1.724
21	11/320	.0344	± .001	25	1.580
22	1/32	.0312	± .001	22-3/4	1.437
23	9/320	.0281	± .001	20-1/2	1.293
24	1/40	.0250	± .001	18-1/4	1.149
25	7/320	.0219	± .001	16	1.005
26	3/160	.0188	± .001	13-3/4	0.862
27	11/640	.0172		12-1/2	.7901
28	1/64	.0156		11-1/4	.7183

*Based on a density of 8.85 grams per cubic centimeter or approximately 552.4 lbs. per cubic foot.

**To the nearest 1/4 ounce.

TABLE 16.- Permissible Variations in Thickness of Monel Metal Plates, Sheets, and Strips, U. S. Army Ordnance Department Metal Specifications, No. 57-168, May 15, 1923

Thickness	Widths	Permissible variation
Inches	Inches	Inch
0.02 and less................	All widths.......	±0.002
Over 0.02 to 0.04 inclusive..	....do..........	± .003
Over 0.04 to 0.065 inclusive.	....do..........	± .004
Over 0.065 to 0.08, inclusive.	....do..........	± .005
Over 0.08 to 0.1, inclusive.	....do..........	± .006
Over 0.1 to 0.12, inclusive.	....do..........	± .007
Over 0.12 to 0.25, inclusive.	... do..........	± .008
Over 0.25...................	48 and less......	± 5 per cent
Do....................	Over 48 to 60, inclusive	Plus 5 per cent; minus 7 per cent.
Do....................	Over 60.........	Plus 5 per cent; minus 8 per cent.

4. Sheet Zinc Gage

The Sheet Zinc Gage, commonly used by manufacturers of zinc sheet in the United States, is given in Table 17. The weights per square foot for the thicknesses given are based on a density of 7.19 grams per cubic centimeter or 448.9 pounds per cubic foot. The permissible variations in thickness are those adopted by the U. S. Army, as given in Ordnance Department Metal Specifications No. 57-156, June 2, 1923.

TABLE 17.- American Sheet Zinc Gage

1	2	3	4	
Gage No.	Thickness	Weight per sq.ft.	Permissible variations in thickness	
	Inches	pounds	Minus	Plus
1	0.002	0.07	0.000	0.002
2	.004	.15	.000	.002
3	.006	.22	.000	.002
4	.008	.30	.000	.002
5	.010	.37	.000	.002
6	.012	.45	.000	.002
7	.014	.52	.000	.002
8	.016	.60	.000	.002
9	.018	.67	.000	.002
10	.020	.75	.000	.004
11	.024	.90	.000	.004
12	.028	1.05	.000	.004
13	.032	1.20	.000	.004
14	.036	1.35	.000	.004
15	.040	1.50	.000	.005
16	.045	1.68	.000	.005
17	.050	1.87	.000	.005
18	.055	2.06	.000	.005
19	.060	2.24	.000	.005
20	.070	2.62	.000	.005
21	.080	2.99	.000	.005
22	.090	3.37	.000	.005
23	.100	3.74	.000	.005
24	.125	4.68	.000	.005
25	.250	9.35	.000	.005
26	.375	14.03	.000	.005
27	.500	18.70	.000	.005
28	1.000	37.40	.000	.005

IV. FOREIGN SHEET AND PLATE GAGES

1. Birmingham Gage, B.G. (British Legal Standard)

The Board of Trade, Standards Department, England, passed an Order in Council, on July 16, 1914, giving legal sanction to the Birmingham Gage, B.G., for iron and steel sheets, hoops, etc. The enumeration and sizes of the B.G. gage was first issued by the South Staffordshire Ironmaster's Association, March 1, 1884, and came into more or less general use in the British sheet steel and hoop iron trade. By 1914 the B.G. series of sizes was recognized by most of the sheet steel rollers and galvanizers, and tin plate and hoop iron manufacturers in England; and upon petition of various Chambers of Commerce in the United Kingdom, the Board of Trade proceeded to have the gage legalized. See Table 18.

2. Paris or French Gage

The "Jauge de Paris", given in Table 19, is a gage for sheet metal and wire, which has been in use in France since 1857. It is a thickness gage established by custom. The weights of sheet steel given in Table 14 are computed on the basis of 0.2833 pounds per cubic inch.

3. German Standards for Non-Ferrous Sheets

Standard thicknesses, tolerances on thickness, and weights of brass, copper, and aluminum sheets adopted by the Normenausschuss der Deutschen Industrie and and published in Dinormen 1751, 1752, and 1753, respectively, are given herein in Tables 20, 21 and 22. The weights given are based on the following densities: Brass, 8.5 grams per cubic centimeter or 530.6 pounds per cubic coot; copper, 8.9 grams per cubic centimeter or 555.6 pounds per cubic foot; and aluminum 2.73 grams per cubic centimeter or 170.4 pounds per cubic foot.

4. Continental Zinc Gage

The Continental Zinc Gage, given in Table 23, is used throughout Belgium, France, and Germany for zinc sheets. The metric sizes and weights given in Table 15 are taken from Fascicule A 33-2, January 27, 1923, of the Commission Permanente de Standardization, France, entitled "Cahier des Charges pour la Fourniture du Zinc Industriel".

Table 18. - British Sheet and Hoop Iron Standard Gage (Birmingham Gage, B.G.)

1	2	1	2	1	2
Descriptive Number	Equivalents in decimal parts of an inch	Descriptive Number	Equivalents in decimal parts of an inch	Descriptive Number	Equivalents in decimal parts of an inch
No.	Inches	No.	Inches	No.	Inches
15/0 B.G.	1.000	8 B.G.	0.1570	30 B.G.	0.0123
14/0 B.G.	0.9583	9 B.G.	.1398	31 B.G.	.0110
13/0 B.G.	.9167	10 B.G.	.1250	32 B.G.	.0098
12/0 B.G.	.8750	11 B.G.	.1113	33 B.G.	.0087
11/0 B.G.	.8333	12 B.G.	.0991	34 B.G.	.0077
10/0 B.G.	.7917	13 B.G.	.0882	35 B.G.	.0069
9/0 B.G.	.7500	14 B.G.	.0785	36 B.G.	.0061
8/0 B.G.	.7083	15 B.G.	.0699	37 B.G.	.0054
7/0 B.G.	.6666	16 B.G.	.0625	38 B.G.	.0048
6/0 B.G.	.6250	17 B.G.	.0556	39 B.G.	.0043
5/0 B.G.	.5883	18 B.G.	.0495	40 B.G.	.00386
4/0 B.G.	.5416	19 B.G.	.0440	41 B.G.	.00343
3/0 B.G.	.5000	20 B.G.	.0392	42 B.G.	.00306
2/0 B.G.	.4452	21 B.G.	.0349	43 B.G.	.00272
1/0 B.G.	.3964	22 B.G.	.03125	44 B.G.	.00242
1 B.G.	.3532	23 B.G.	.02782	45 B.G.	.00215
2 B.G.	.3147	24 B.G.	.02476	46 B.G.	.00192
3 B.G.	.2804	25 B.G.	.02204	47 B.G.	.00170
4 B.G.	.2500	26 B.G.	.01961	48 B.G.	.00152
5 B.G.	.2225	27 B.G.	.01745	49 B.G.	.00135
6 B.G.	.1981	28 B.G.	.015625	50 B.G.	.00120
7 B.G.	.1764	29 B.G.	.0139	51 B.G.	.00107
				52 B.G.	.00095

N.B. It is important that in all transactions in sheet and hoop iron the initial letters B.G. should appear to distinguish the Sheet and Hoop Iron Standard Gage from other gages.

Table 19. - Paris or French Gage for Sheets and Wires

1 Number of Gage	2 Thickness in millimeters	3 Approximate thickness in inches	4 Approximate weight per square meter in kilograms, sheet steel	5 Approximate weight per square meter in pounds, avoirdupois, sheet steel
P15	0.15	0.0059	1.176	2.593
P14	.16	.0063	1.255	2.766
P13	.17	.0067	1.333	2.939
P12	.18	.0071	1.412	3.112
P11	.20	.0079	1.568	3.458
P10	.22	.0087	1.725	3.803
P 9	.23	.0091	1.804	3.976
P 8	.25	.0098	1.960	4.322
P 7	.27	.0106	2.117	4.668
P 6	.28	.0110	2.196	4.841
P 5	.30	.0118	2.353	5.186
P 4	.34	.0134	2.666	5.878
P 3	.37	.0146	2.901	6.397
P 2	.42	.0165	3.294	7.261
P 1	.46	.0181	3.607	7.952
P 0	.50	.0197	3.921	8.644
1	.6	.0236	4.705	10.37
2	.7	.0276	5.489	12.10
3	.8	.0315	6.273	13.83
4	.9	.0354	7.058	15.56
5	1.0	.0394	7.842	17.29
6	1.1	.0433	8.626	19.02
7	1.2	.0472	9.410	20.75
8	1.3	0.0512	10.19	22.47
9	1.4	.0551	10.98	24.20
10	1.5	.0591	11.76	25.93
11	1.6	.0630	12.55	27.66
12	1.8	.0709	14.12	31.12
13	2.0	.0787	15.68	34.58
14	2.2	.0866	17.25	38.03
15	2.4	.0945	18.82	41.49
16	2.7	.1063	21.17	46.68
17	3.0	.1181	23.53	51.86
18	3.4	.1339	26.66	58.78
19	3.9	.1535	30.58	67.42
20	4.4	.1732	34.50	76.07
21	4.9	.1929	38.42	84.71
22	5.4	.2126	42.35	93.35
23	5.9	.2323	46.27	102.0
24	6.4	.2520	50.19	110.6
25	7.0	.2756	54.89	121.0
26	7.6	.2992	59.60	131.4
27	8.2	.3228	64.30	141.8
28	8.8	.3465	69.01	152.1
29	9.4	.3701	73.71	162.5
30	10.0	.3937	78.43	172.9

The weights given in columns 4 and 5 are based on a density of 0.2833 lbs. per cu. in. (489.6 lbs. per cu. ft.) or approximately 7841.7 kg per cubic meter.

TABLE 20.- Thicknesses of Cold-Rolled Brass Sheets, - German Industry Standard (DIN 1751, July 1925)

1	2	3	4	5	6	7	8	9	10	11	12
Thickness		Permissible variations in thickness for widths of:								Approximate weight per square meter in kilograms	Approximate weight per square foot in pounds avoirdupois
		350 to 500 mm (13.78 to 19.68 inches)		350 to 600 mm (13.78 to 23.62 inches)		Over 600 to 750 mm (Over 23.62 to 29.53 inches)		Over 750 to 1000 mm (Over 29.53 to 39.37 inches)			
mm	Inches approx.	mm	Inches approx.	mm	Inches approx.	mm	Inches approx.	mm	Inches approx.		
0.10	0.0039	±0.015	±0.0006							0.85	0.174
.15	.0059	± .015	± .0006							1.27	.261
.20	.0079	± .015	± .0006							1.70	.348
.25	.0098	± .020	± .0008							2.12	.435
.30	.0118	± .020	± .0008							2.55	.522
.35	.0138	± .030	± .0012							2.97	.609
.40	.0157	± .030	± .0012							3.40	.696
.45	.0177			±0.035	±0.0014					3.82	.801
.50	.0197			± .035	± .0014	±0.060	±0.0024			4.25	.870
.60	.0236			± .035	± .0014	± .060	± .0024			5.10	1.045
.70	.0276			± .035	± .0014	± .060	± .0024			5.95	1.219
.80	.0315			± .040	± .0016	± .060	± .0024			6.80	1.393
.90	.0354			± .040	± .0016	± .070	± .0028			7.65	1.567
1.00	.0394			± .040	± .0016	± .070	± .0028	±0.090	±0.0035	8.50	1.741
1.20	.0472			± .040	± .0016	± .080	± .0031	± .110	± .0043	10.20	2.089
1.50	.0591			± .050	± .0020	± .080	± .0031	± .110	± .0043	12.75	2.612
1.80	.0709			± .060	± .0024	± .100	± .0039	± .130	± .0051	15.30	3.134
2.00	.0787			± .060	± .0024	± .100	± .0039	± .130	± .0051	17.00	3.482
2.50	.0984			± .080	± .0031	± .120	± .0047	± .150	± .0059	21.25	4.352
3.00	.1181			± .080	± .0031	± .120	± .0047	± .150	± .0059	25.50	5.223
3.50	.1378			± .100	± .0039	± .150	± .0059	± .170	± .0067	29.75	6.094
4.00	.1575			± .100	± .0039	± .150	± .0059	± .170	± .0067	34.00	6.964

Note: The points of measurement for thickness shall be at least 100 mm from the corners and 40 mm from the edges of the sheet.

TABLE 21.- Thicknesses of Cold-Rolled Copper Sheets, - German Industry Standard (DIN 1752, July, 1925)

1	2	3	4	5	6
Thickness		Permissible variation in thickness		Approximate weights per square meter in kilograms	Approximate weight per square foot in pounds, avoirdupois
mm	Inches approx.	mm	Inches approx.		
0.10	0.0039	±0.015	±0.0006	0.89	0.182
.15	.0059	± .015	± .0006	1.33	.273
.20	.0079	± .015	± .0006	1.78	.365
.22	.0087	± .015	± .0006	1.96	.401
.25	.0098	± .020	± .0008	2.22	.456
.28	.0110	± .020	± .0008	2.49	.510
.30	.0118	± .020	± .0008	2.67	.547
.35	.0138	± .030	± .0012	3.11	.638
.40	.0157	± .040	± .0016	3.56	.729
.45	.0177	± .040	± .0016	4.00	.820
.50	.0197	± .040	± .0016	4.45	.911
.60	.0236	± .050	± .0020	5.34	1.094
.70	.0276	± .060	± .0024	6.23	1.276
.80	.0315	± .070	± .0028	7.12	1.458
.90	.0354	± .070	± .0028	8.01	1.641
1.00	.0394	± .080	± .0031	8.90	1.823
1.20	.0472	± .100	± .0039	10.68	2.187
1.50	.0591	± .110	± .0043	13.35	2.735
1.80	.0709	± .130	± .0051	16.02	3.281
2.00	.0787	± .130	± .0051	17.80	3.646

Note: The points of measurement for thickness shall be at least 100 mm from the corners and 40 mm from the edges of the sheet.

TABLE 22.- Thicknesses of Cold-Rolled Aluminum Sheets,- German Industry Standard (DIN 1753, July 1925)

1	2	3	4	5	6	7	8	9	10	11	12
Thickness		Permissible variations in thickness for widths of:								Approximate weight per square meter in kilograms	Approximate weight per square foot in pounds, avoirdupois
		350 to 500 mm (13.78 to 19.68 inches)		350 to 600 mm (13.78 to 23.62 inches		Over 600 to 750 mm (Over 23.62 to 29.53 inches)		Over 750 to 1000 mm (Over 29.53 to 39.37 inches)			
mm	Inches approx.	mm	Inches approx.	mm	Inches approx.	mm	Inches approx.	mm	Inches approx.		
0.20	0.0079	±0.015	±0.0006							0.55	0.112
.25	.0098	± .020	± .0008							.68	.140
.30	.0118	± .020	± .0008							.82	.168
.35	.0138	± .030	± .0012							.96	.196
.40	.0157	± .030	± .0012							1.09	.224
.45	.0177			±0.035	±0.0014					1.23	.252
.50	.0197			± .035	± .0014	±0.050	±0.0020			1.37	.280
.60	.0236			± .035	± .0014	± .050	± .0020			1.64	.335
.70	.0276			± .035	± .0014	± .050	± .0020			1.91	.391
.80	.0315			± .040	± .0016	± .050	± .0020			2.18	.447
.90	.0354			± .040	± .0016	± .060	± .0024			2.46	.503
1.00	.0394			± .040	± .0016	± .060	± .0024	±0.080	±0.0031	2.73	.559
1.10	.0433			± .040	± .0016	± .070	± .0028	± .090	± .0035	3.00	.615
1.20	.0472			± .040	± .0016	± .070	± .0028	± .090	± .0035	3.28	.671
1.30	.0512			± .050	± .0020	± .070	± .0028	± .090	± .0035	3.55	.727
1.40	.0551			± .050	± .0020	± .070	± .0028	± .090	± .0035	3.82	.783
1.50	.0591			± .050	± .0020	± .070	± .0028	± .090	± .0035	4.09	.839
1.80	.0709			± .060	± .0024	± .090	± .0035	± .110	± .0043	4.91	1.007
2.00	.0787			± .060	± .0024	± .090	± .0035	± .110	± .0043	5.46	1.118
2.20	.0866			± .060	± .0024	± .090	± .0035	± .110	± .0043	6.01	1.230
2.50	.0984			± .080	± .0031	± .110	± .0043	± .130	± .0051	6.83	1.398
3.00	.1181			± .080	± .0031	± .110	± .0043	± .130	± .0051	8.19	1.677
3.50	.1378			± .100	± .0039	± .130	± .0051	± .150	± .0059	9.55	1.957
4.00	.1575			± .100	± .0039	± .130	± .0051	± .150	± .0059	10.92	2.237
4.50	.1772			± .120	± .0047	± .150	± .0059	± .170	± .0067	12.28	2.516
5.00	.1968			± .120	± .0047	± .150	± .0059	± .170	± .0067	13.65	2.796

Note: The points of measurement for thickness shall be at least 100 mm from the corners and 40 mm from the edges of the sheet.

TABLE 23.- Continental Zinc Gage

1	2	3	4	5
Gage Number	Thickness		Weight per square meter	Weight per square foot
	mm	Inches	Kilograms	Pounds
1	0.100	0.0039	0.700	0.14
2	.143	.0056	1.001	.20
3	.186	.0073	1.302	.27
4	.228	.0090	1.596	.33
5	.250	.0098	1.750	.36
6	.30	.0118	2.100	.43
7	.35	.0138	2.450	.50
8	.40	.0157	2.800	.57
9	.45	.0177	3.150	.65
10	.50	.0197	3.500	.72
11	.58	.0228	4.060	.83
12	.66	.0260	4.620	.95
13	.74	.0291	5.180	1.06
14	.82	.0323	5.740	1.18
15	.95	.0374	6.650	1.36
16	1.08	.0425	7.560	1.55
17	1.21	.0476	8.470	1.73
18	1.34	.0528	9.380	1.92
19	1.47	.0579	10.290	2.11
20	1.60	.0630	11.200	2.29
21	1.78	.0701	12.460	2.55
22	1.96	.0772	13.720	2.81
23	2.14	.0843	14.980	3.07
24	2.32	.0913	16.240	3.33
25	2.50	.0984	17.500	3.58
26	2.68	.1055	18.760	3.84